1. Generalities

1.1. Destination

User Manual refers to low voltage automatic capacitor banks QAR2 type 3x400Vca, 50Hz, for polluted networks with higher current and voltage harmonics (where there is a significant number of electronic loads as rectifiers, inverters, etc.) the capacitor banks are equipped also with antiresonance (detunning) reactors. We shall refer to it as "capacitor bank" or "equipment".

1.2. Symbolization

The symbolization represent a letter and numbers group with the following meanings:

QAR2 - -/ - - : manufacturer code

QAR2: Low voltage and power capacitor banks with detuned reactors.

- -/ : total reactive power, in kvar
- - : number of steps and reactive controller used type

1.3. This equipment is for indoor use, with following conditions:

- without corrosive agents, electricity conductor powder, explosive or dust atmosphere (max. 1mg/cbm)

- Ambient temperature
  - minim temperature – 10°C
  - maxim temperature + 40°C
  - medium daily temperature < + 30°C
  - medium annual temperature < +25°C
  - relative humidity < 80% la –20°C
  - climate zone: N
  - We recommend installing so that the equipment is protected from direct solar radiation or other heat sources;
  - Indoor rooms must have a good ventilation. For ventilation must be used air conditioner or exhaust system properly dimensioned with inlet air filter.

1.4. Manufacturing standard : EN 60439-1

1.5. **Warning**: It is mandatory that the beneficiary is informed of the contents of these instructions before installing and operating equipment.Failure to comply will lead to removal from the warranty.

2. DATA SHEET

2.1. Electric diagram: annex 2.

2.2. Main technical characteristics: annex 1

2.3. Torque coupling assembly :

M6	M8	M10	M12
6Nm	15Nm	30Nm	55Nm

2.4. Lifetime: 15 years, compliance with user manual instructions.

3. CHECK THE RECEPTION EQUIPMENT

Before the installation, please check the following:

3.1. The equipment was not hit or damaged during transport.

3.2. Equipment supplied is the type ordered by you and is what you need.

3.3. Mains rated voltage is the same voltage specified on the equipment label

3.4. User manuals for capacitor bank and for reactive controller was delivered with the equipment.

4. DESCRIPTION

4.1. The equipment is included in a metallic enclosure to be fix on the sturdy floor. The metallic part of enclosure is electrostatic painted with RAL 7035 color. The enclosure have one front door.

4.2. Inside the enclosure there are:

1) Special capacitor contactors with leading inrush current limiting resistances;
2) Cylindrical aluminum case, low-loss, self healing with overpressure protection, dry, gas, long life (>130.000h) capacitors;
3) Highly reliable automatic power factor regulator with voltage, current , PF and current THD displays, alarms for overvoltage, over and under compensation;
4) Fuse switch disconnectors with NH fuses for groups of capacitors;
5) 7% three phase detunning reactors, vacuum impregnated, temperature protected;
6) Forced ventilation;

5. HOW IT WORKS

Please see the electric diagram -annex 2. Depending on the reactive power consumption the automatic power factor regulator switches the contactors that introduce capacitor steps just enough to provide the necessary reactive current. The user must set the target of cos FI (read the regulator manual).The default value of cos FI is 0.98.

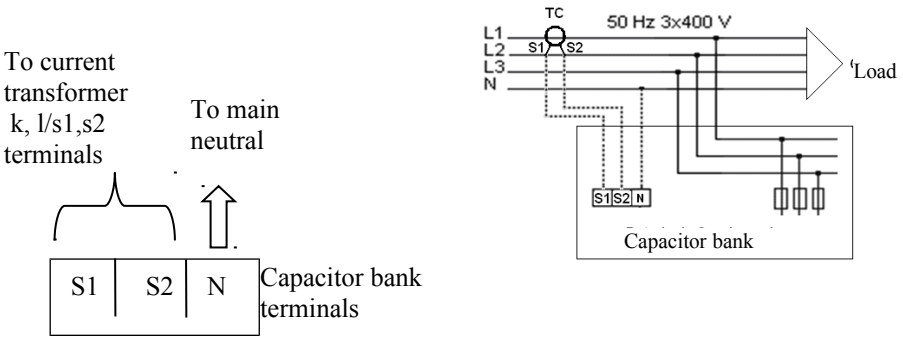
Between two same step connection the regulator waits for capacitors discharging (reconnection time). Inputs requested:

- total load current from a current transformer …/5A (minim power 5VA) mounted on L1 of three phase mains. We recommend that the current transformer must be mounted alongside the current transformer of energy meter and must measure the total current (loads+capacitor bank).

Warning: the capacitor bank does not include the current transformer!

6. LOCATION AND INSTALLATION

6.1. The capacitor bank must be installed on sturdy floor standing, away from sources of heat. In fig. 1 you can see the output connections (to current transformer and supply network):



6.2. The connection to the mains of the capacitor bank should be made with copper cable with 1000V isolation voltage and the section in complience with maximum current input (see annex 1). Warning: the phase sequence connection must be from left to right L1, L2, L3 and N terminal conductor will be copper cable with 4mm2 section.
6.3. The current input (equipment terminals S1, S2) comes from a current transformer …/5A (minim power 5VA) mounted on L1 of the three phase mains. It will be used only for the capacitor bank. The connection conductor from current transformer to S1/S2 terminals will be copper cable with 2.5 mm2 section. If the distance to the capacitor bank is more than 5 m, please use 4mm2 cable.
6.5. The capacitor bank metallic enclosure will be connected to ground belt with copper cable with adequate section (see annex 1).

7. PREPARATION FOR COMMISSIONING AND OPERATION

7.1. Check (with ohmmeter) continuity of earthing circuit protection.
7.2. Check tightening screws to power and control terminals (contactors, separators, capacitors terminals).
7.3. Check base menu of automatic power factor controller and change the parameters if needed (see DCRL5 instruction manual). Pay attention on P.01-CT primary, P.03 -CT read phase = L1, P.05-Voltage = L2-L3, P.06-smallest step power, etc. You can see the default parameters in annex 1.
7.4. Check that the power fuse disconnectors are closed, then close control MCB. In the beginning the pf controller displays loads power factor. This power factor must be inductive, between 0.6-0.9. If enough loads are connected, the pf controller should close enough capacitor steps, and power factor displayed increases up to target set. If the power factor displayed is capacitive you must reverse cables in S1 and S2 terminals, then see the display. If now we have inductive power factor and the equipment will begin to connect the capacitors, the installation is well done. Disconnect some loads and check if power factor becomes capacitive and after that the equipment will disconnect some steps. Finally the power factor will become

close to target PF set. When there is no load connected to the mains, the equipment must disconnect all steps (please check!).

8. PERIODIC MAINTENANCE

8.1. Maneuvering by unskilled and untrained personnel is prohibited! Working personnel should wear appropriate protective equipment in working time and must know the operating and installation instructions.

8.2. Operation of equipment with the doors open is forbidden.

8.3. All maintenance operations are performed by trained personnel (authorized electricians for JT), without voltage (by disconnecting the bank supply breaker). After disconnection wait 10 minutes, then check voltage at the terminals of capacitors!

8.4. In the first month please check:

- the supply voltage, especially during periods when the load is small

- temperature inside the cabinet
- visual the condition of capacitors, reactors, contactors and connection cables
- measure the current through capacitors with a measuring device, should not exceed 1.1xIn (see Annex 1).
- tighten loose connections from contactors, breakers, capacitors, coils (after disconnecting the battery from the mains and after 10 minutes necessary for discharging and checking the absence of voltage with a measuring device!)

8.5. Every day check the proper functioning of the capacitor bank by viewing the information on the display controller: power factor value and possible alarms. Check the controller has disconnected capacitor steps without loads (eg, upon completion of the work program).

8.6. For forced cooled capacitor banks, the filters and the cabinet must be cleaned of dust by vacuuming once a month. Change the filter if it is too clogged. *This operation is written in the maintenance sheet.* Check weekly visual the dust and if exists electrical metallic powders on bars, bars supports, devices (disconnectors, circuit breakers, capacitors, contactors) and if it exists, clean the equipment. Check dust or metal powders source and try to remove it.

8.7. Every four months check the status of electrical contacts of terminals circuit breakers / disconnectors, coils, contactors and capacitors, tighten weakened contacts or take measures to replace equipment or cable connection that shows signs of damage (with excessive heating of the insulation, melting, etc.).Inspect for soot stains on contactors and if there is, check the state of electric contacts. If damaged, replace the contactor! Check the status of earthing connections with the measure device!*This operation is written in the maintenance sheet.* **Each month see the electricity bill to check the proper functioning of the system. If this notice the reactive energy (inductive or capacitive) in excess, contact the installer for checking the battery.**

9.MARKING, TRANSPORT, STORAGE, ACCOMPANYING DOCUMENTS, DELIVERY COMPONENTS

9.1. Marking

product label includes:

- producing company name;
- the name and type of product ;
- year and the number of manufacturing ;
- rated parameters

9.2. Transport

The capacitor bank can be transported by trucks or by rail. During transport, installation will be anchored properly, will not be hit, smashed and will be protected from strong vibrations.

9.3. Storage

Storing at beneficiary will be in closed room, with climatic conditions described in paragraph 1.3.

9.4. Accompanying documents

Manufacturer offers beneficiary the following technical documentation:

- electrical diagram
- capacitor bank user manual
- controller user manual
- warranty certificate and declaration of conformity

9.5. Delivery components

A complete delivery kit must content::

– capacitor bank
– accompanying documents

10. LABOR AND FIRE PROTECTION RULES.

10.1. Observe all working safety conditions and fire regulations stipulated in current standards for low voltage installations.

10.2. All maintenance activities shall be made only after removing the power supply.

10.3. After the power supply is disconnected, wait for approx. 10 min. for capacitors discharge

10.4. check with the voltmeter the capacitor terminals, must have no voltage!

10.5. After that you can do the work.

10.6. During the operation, cabinet door will be closed with special key that will be kept by the maintenance electrician

11. ENVIRONMENTAL PROTECTION

11.1. 15 years lifetime.

11.2.After the lifetime, capacitor bank will be delivered to recovery and recycled materials companies.

11.3. Recoverable materials: steel enclosure, etc., copper cables, plastics;

11.4. All components of the materials comply with environmental standards.

11. TROUBLE SHOOTING TABLE

No	PROBLEMS	CHECKS
1	The display controller does not light	**1.** The main breaker / separator and / or command circuit breaker / separator is OFF. **2.** Power or command fuses and / or are burned. **3.** The supply voltage is no present at the input terminals of the capacitor bank: check with the voltmeter
2	After the power supply coupling, displayed PF (power factor) is capacitive even if no capacitor step is connected	1. Reverse terminals S1, S2 measure current transformer connections 2. Check again phasing L1, L2, L3 to the input terminals and if CT (current transformer) is mounted on phase L1.
3	When coupling power supply the PF displayed is inductive but the capacitor bank doesn't insert steps	1. The amount of power reactive required is less than the value of the first stage of the bank. You must turn on more loads (you can read the value of the necessary reactive power displayed by controller) 2. Inductive PF value is close to the programmed value, it does not need steps connection
4	When coupling power supply the PF displayed is inductive, the capacitor bank insert steps, but PF displayed don't change	1. CT (current transformer) was wrong placed, measuring only the load current, don't measure total current (load + bank current) 2. Capacitor bank power is much smaller than required reactive power. Order a biggest capacitor bank or make an extension of the existing one
5	During start up, the display doesn't show PF value,it displays an alarm code and the capacitor bank does not connect steps.	**1.** There are no loads / consumers connected to the network or load current value is very small. **2.** Check the alarm code significance in user manual controller
6	PF displayed is inductive, capacitor bank connects steps, PF value increases but does not reach the set value, with all the steps inserted into the circuit	1. The capacitor bank is undersized, check the display for reactive power required value and order an extension. 2. Check fuses, could be burned 3. Check capacitors, may have less value because of the burning of sections 4. Check the condition of contactors, if power contacts are in good condition

12. ANNEXES

- electrical diagram
- Technical information

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ANNEX 1

Capacitor banks type QAR2-200-5L

Technical information:

- voltage supply: 3x400V, 50Hz
- control circuit voltage supply: 230V, 50Hz
- Total reactive power: 200 kvar
- steps: 2x25+3x50 kvar
- rated current: 289A
- maximum current (for electrical sizing switches / connection cable): 413.3A
- dimensions: 1500x800x400mm
- weight: 240 kg
- degree of protection: IP 21
- permissible short circuit current : 35 kA
- location : indoor

Recommended values :

The copper single phase cable for power supply	150mm^2/ phase
The copper single phase cable for ground connection	75 mm^2
Breaker / fuse protection at starting power cable	400A
Current transformer pre-setting value	400/5A

PARTS LIST:

Capacitors, reactors			contactors		fuses	
Symbol	Reactive power/ voltage [kvar/ V]	Rated current [A]	Symbol	Reactive power [kvar]	Symbol	Current [A]
C1,C2, C3,C4, C5,C6, C7,C8	28kvar/440V	36.8	K1, K2	25	F1,F2, F3	160
L1,L2	25kvar,400V, 189Hz,7%	43	K3, K4, K5	50	Q01	4
L3,L4, L5	50kvar,400V, 189Hz,7%	86				

Controller: type DCRL5,5 steps, LOVATO

AUTOMATIC CAPACITOR BANK FOR POWER FACTOR CORRECTION

200kVAr/ 400V

type QAR2 200- 5L

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